

**The Pyrolytic Stove:**  
**The beginning of the end of deforestation in Tanzania?**

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**3,000 TONS of charcoal produced per day in Tanzania**

**(Approx. 1,500 full lorries per day)**



- Pyrolytic Stove**
- 1) Uses agricultural & wood waste (maize & rice stalks etc.) for fuel (no deforestation). **(Benefit #1)**
  - 2) While burning, the stove pyrolyzes pellets into:
    - a) methane for immed. cooking (no storage) **(Benefit #2)**
    - b) biochar for fertilizer **(Benefit #3)**
  - 3) Eliminates smoke from house, reducing respiratory disease. **(Benefit #4)**
  - 4) Biochar from stove, after applied to soil, is a fertilizer "catalyst" – it holds on to nutrients and feeds them to plants.
  - 5) Biochar remains in soil for centuries, storing carbon (so that it does not become CO<sub>2</sub> (global warming) **(Benefit #5)**
- International carbon offset funds can be earned for sequestering carbon in soil AND for reducing deforestation.


**The Pyrolytic Stove**

**Pyrolysis** is the burning of biomass (wood etc.) in the absence of oxygen



Charcoal (*maka*) production is a pyrolytic process.

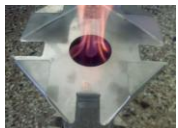
Other compounds in wood are vaporized away.

The unburned material (pure carbon) that remains is known as biochar (biochar = charcoal)



Lucia Stove from Worldstove Inc. is a type of **pyrolytic** stove. Cost: Tsh 75,000 (\$50)



One load of pellets burns for about 3 hours

Pyrolytic stoves use **pellets** made from wood waste or agricultural residues such as rice stalks etc.

Pellets



### Cooking Smoke Inhalation:

Causes more deaths in Africa than malaria

Developing Countries	Number of Deaths	Developed Countries	Number of Deaths
1. HIV/AIDS	2 678 000	1. Ischaemic heart disease	3 512 000
2. Lower respiratory infections	2 643 000	2. Cerebrovascular disease	3 346 000
3. Ischaemic heart disease	2 484 000	3. Chronic obstructive pulmonary disease	1 829 000
4. Diarrhoeal diseases	1 793 000	4. Lower respiratory infections	1 180 000
5. Cerebrovascular disease	1 381 000	5. Trachea/bronchus/lung cancers	938 000
6. Childhood diseases	1 217 000	6. Road traffic accidents	669 000
7. Malaria	1 103 000	7. Stomach cancer	657 000
8. Tuberculosis	1 021 000		
9. Chronic obstructive pulmonary disease	748 000		
10. Measles	674 000		

The Lucia stove is nearly smokeless



### Biochar from fuel pellets



Biochar is an important new “fertilizer” for Africa – it is actually a soil fertility “enhancer”.

**nature REPORTS climate change**  
the news behind the science, the science behind the news

**The bright prospect of biochar**

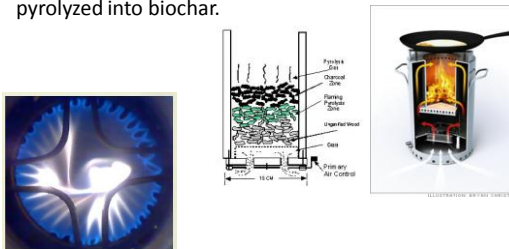
**Estimates say that biochar could go a long way towards mitigating climate change and bring with it a host of exciting benefits, but where there is good, there is also bad. *Ken Galloway reports.***

Jim Fournier wants to help save the planet, though in a most unlikely way: by burning biomass. As the founder of a carbon-sequestration technology that proponents say offers a rare “win-win-win” environmental opportunity, Fournier’s company Biochar Engineering in Golden, Colorado, manufactures machines that turn biomass into charcoal, or biochar.

Spread on soil, biochar can keep CO<sub>2</sub> out of the atmosphere while improving soil fertility and boosting productivity. In addition, gases released in the charcoal-making process can be used to make biofuels that are more sustainable than those currently on the market. “Char happens to be the one thing that represents a solution to all of these factors together. It’s a unique opportunity,” Fournier says.

“Using charcoal on the soil can promote both plant growth and an increasing carbon sequestration.”

–The pyrolytic stove heats biomass pellets in such a way that gas (mostly methane) is emitted from superheated pellets and is then channeled to the top of the stove and burned, while the remaining biomass is pyrolyzed into biochar.



When wood burns, it is actually the gases from the superheated wood that are burning.

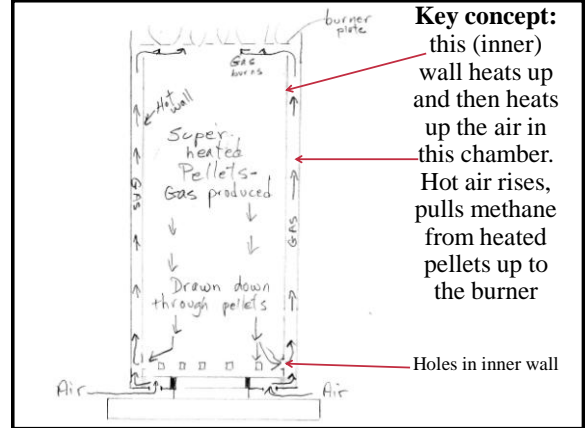


In the presence of oxygen, all of the carbon is combusted.

-The Lucia stove is a particular type of pyrolytic stove designed by Nathaniel Mulcahey. It is low cost and brilliantly conceived.



Open Air Pyrolytic Biochar Production.mp4



**Key concept:** this (inner) wall heats up and then heats up the air in this chamber. Hot air rises, pulls methane from heated pellets up to the burner

Fuel production for pyrolytic stoves

- 1) Hammer mill crushes stalks into powder (like sawdust)



wholly.en.alibaba.com



- 2) Pelletizer makes pellets from powder



Biochar and soil fertility

1,000 year old biochar deposits are still fertile

Figure 2. Dark earth from the Amazon, with biochar which accumulated about 800 years before present and still shows a distinctly black color, indicating the high stability of biochar (compare black topsoil with the yellow underlying material in



Biochar added to soil

-Biochar is a new and important fertilizer. It is important for holding on to nutrients and preventing them from leaching (washing) during rains.



Figure 12 Maize crop trials at BEST Energies, Scone, NSW. The plants on the right have been grown only with fertiliser, those on the left with fertiliser + biochar. Sourced from BEST (2008).

### Biochar as soil amendment



Figure 2 Crop trials with 'terra preta' additions to the soil shown on the left. Sourced from Marris (2006).

International Carbon Offset funds will be available for:

- 1) Storing biochar in soil
- 2) Reducing deforestation

This project proposal is based on Eric Reynolds' groundbreaking Inyenyeri project in Rwanda and Eric's generous support.

[www.inyenyeri.org](http://www.inyenyeri.org)

The New York Times  
The Opinion Pages

WORLD U.S. N.Y. / REGION BUSINESS TECHNOLOGY SCIENCE HEALTH SPORTS

**On the Ground**  
NICHOLAS D. KRISTOF

June 13, 2011 1:50 PM

**A Low-Impact Stove for Rwanda**  
LUCIA STOVE

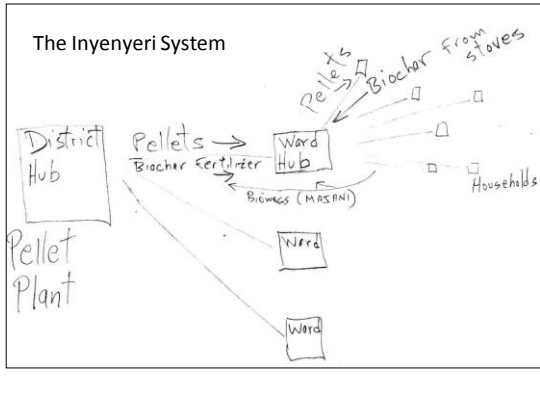
Last year, Eric Reynolds, the co-founder of the outdoor sports gear company Marnist, contacted me with an aggressive business plan for rolling out fuel-efficient, low-pollution cookstoves across Rwanda. Having seen dozens of entrepreneurial projects in Rwanda start with a big bang and then founder for lack of momentum and commitment, I initially bristled off his enthusiasm. I gently explained that he would have to move to Rwanda if he was to get anything done, and he explained that this was exactly his plan.

When Eric rolled into town a few months later and announced that he had decided to, in his words, "spend his here," I was pleasantly surprised.

YLUNG CE  
Small-scale pellet machine

Medium-scale pellet plant

### The Inyenyeri System



### Where do we go from here?

Need:

- Business plans
- Two people to visit Inyenyeri Project in Rwanda (Tsh 750,000)
- Investors / funders
- Trial stoves (Tsh 150,000)
- Hammer mill(Tsh 600,000), pelletizer (1,500,000)